

CALIFORNIA ENERGY COMMISSION

1516 NINTH STREET
SACRAMENTO, CA 95814-5512



DATE: December 23, 2003

TO: Interested Parties

FROM: Donna Stone, Compliance Project Manager

SUBJECT: **Moss Landing Power Project (99-AFC-4C)**
Staff Analysis of Proposed Project Modification:
Request to Modify Air Emissions during Startup and Tuning

On September 5, 2003, the California Energy Commission (Energy Commission) received a petition to amend the Energy Commission Decision for the Moss Landing Power Project (MLPP). MLPP is a nominally-rated 1,206 MW natural gas-fired power plant for which construction has been completed and commercial operation commenced in July 2002. The power plant is located in the town of Moss Landing in Monterey County, California. The requested project modification is to allow for a minor change in the emission limitations during the startup and tuning of the new combustion turbines.

Energy Commission staff reviewed the petition to assess the impacts of this proposal on environmental quality, public health and safety. Staff has prepared revisions to the air quality conditions of certification, and added two additional conditions. It is staff's assessment that with the implementation of these conditions, the project will remain in compliance with applicable laws, ordinances, regulations, and standards, and that the modification will not result in any environmental impacts.

The attached staff analysis is provided for your information and review. Energy Commission staff intends to recommend approval of the petition at the January 21, 2004 Business Meeting of the Energy Commission. If you have comments on this proposed project change, please submit them to me at either the address above, fax (916) 654-4745 or e-mail dstone@energy.state.ca.us prior to January 20, 2004. If you have any questions, please call me at (916) 654-4745.

Attachment

Mailed to: List #703

Request To Modify Air Emissions during Startup and Tuning Moss Landing Power Plant (99-AFC-4C)

Prepared by: Matthew Layton
December 10, 2003

AMENDMENT REQUEST

On September 2, 2003, Duke Energy Moss Landing LLC (Duke 2003b) petitioned to amend air quality conditions for the Moss Landing Power Plant (MLPP). Duke also filed to modify permit conditions with the Monterey Bay Unified Air Pollution Control District (District) on May 27 (Duke 2003a) and September 22, 2003 (Duke 2003c). The District issued its analysis of the proposed changes for public comment on October 2, 2003 (District 2003b). The comment period for the District's permit ended November 7, 2003, while the comment period for the federal portion ended November 15, 2003. The District did not receive any substantive comments on the local or federal portions of the revised permit and issued a final Permit To Operate (PTO) December 4, 2003 (District 2003c).

Duke requested to modify the emission limits that apply during steam turbine cold startup and combustor tuning on four new natural gas-fired combustion turbines at MLPP. The daily, quarterly, and annual emission limits that apply to the MLPP would not change, and the new emission limits requested during steam turbine cold startup and combustor tuning would not exceed emission levels previously analyzed by Energy Commission staff in the Final Staff Assessment (CEC 2000a). The requested modification would add definitions of steam turbine cold startups and combustor tuning and add mass-based emission limits for turbine startup and combustor tuning .

BACKGROUND

In May 1999, Duke proposed construction and operation of a major modernization for the Moss Landing Power Plant in Monterey County. The modernization included a new combined-cycle power plant with four General Electric Model 7FA combustion turbine generators (CTGs), heat recovery steam generators, and two condensing steam generators. The MLPP project was certified by the Energy Commission in its October 2000 decision (CEC 2002b). The power plant is now operational, with construction being completed in June 2002. On April 2, 2003, Duke was granted an amendment to shutdown emission limits to incorporated operation experiences with the GE 7FA combustor turbines. After gaining experience operating the plant and other units, Duke has determined that the combustion turbines cannot comply with the existing hourly mass emission limits during steam turbine cold startups and combustor tuning, and are requesting the subject amendment. Warm or hot startup emissions or duration are not being changed.

LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

The California State Health and Safety Code, section 41700, requires that “no person shall discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health, or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property.”

ANALYSIS

Startup and shutdown of the combined-cycle power plant are transient conditions that result in higher emissions than normal operation. During startup and shutdown, combustion temperatures and pressures are rapidly changing, which results in less efficient combustion and higher emissions from the CTGs. The flue gas emission controls, including the selective catalytic reduction system (SCR), operate most efficiently when the turbine operates near or at full load and when the catalysts are at or near their design temperatures. For similar reasons, the emission control systems are less effective during the extended low load operations required for combustor tuning, resulting in higher than operational emissions.

Preliminary startup emissions data were originally used by Duke and staff along with the normal operating data to characterize the air quality impacts from MLPP. Maximum daily emissions were estimated based on the CTGs being in startup mode four hours each day with the remainder of the day in normal operation. Annual emissions were estimated based on 400 hours per turbine per year in a startup mode and 8,000 hours per turbine per year of normal, steady-state operation. Duke believed that normal operating data would adequately reflect these transient conditions. After gaining operating experience, Duke proposes to amend steam turbine cold startup from four hours to six hours and include combustor tuning conditions for up to six hours per event.

AIR QUALITY Table 1 summarizes the proposed start-up and combustor turning emission rates in comparison with the established rates for startup. PM10 and SO₂ are assumed proportionally less than operational levels due to less fuel being combusted during startup or low load combustion tuning.

AIR QUALITY Table 1
Propose CTG Emissions Limits (lbs/hr or lbs/event) per CTG

Operational Profile	NO_x	VOC	CO
Current startup (lbs per four hour event)	320	64	3,608.0
Proposed steam turbine cold startup or tuning (hourly)	285	134	3,500.0
Proposed steam turbine cold startup or tuning (lbs per six hour event)	480	214	5,412.0

AIR QUALITY Table 2 summarizes the proposed worst case start-up and combustor turning emission rates for impacts modeling. The worst case assumes

that only one turbine is operating for a steam turbine cold startup or combustor tuning. The other three turbines are operating a normal load and emissions.

AIR QUALITY Table 2
Worst Case CTG Emissions (lbs/hr or lb/event) per CTG

Operational Profile	NOx	VOC	CO
Steam turbine cold startup or tuning	285	134	3,500
CTG Steady State @ 100% load (hourly)	17.23	4.79	37.76
CTG Steady State @ 100% load (hourly)	17.23	4.79	37.76
CTG Steady State @ 100% load (hourly)	17.23	4.79	37.76
TOTAL	336.7	148.4	3,613.3

AIR QUALITY Table 3 summarizes the proposed start-up and combustor turning modeled emission impacts. When added to worst case background measurements, the maximum impacts are still considerably less than the most restrictive health based standards. Daily and annual standards are not affected by short-term transient events such as steam turbine cold startup or combustion tuning.

AIR QUALITY Table 3
Modeled Impacts from Worst Case CTG Emissions (lbs/hr or lbs/event)

Pollutant	Averaging Period	Impact ($\mu\text{g}/\text{m}^3$)	Back-Ground ($\mu\text{g}/\text{m}^3$)	Total Impact ($\mu\text{g}/\text{m}^3$)	Limiting Standard ($\mu\text{g}/\text{m}^3$)	Percent of Standard
NO ₂	1 hour	88	134	214	470	45.5%
CO	1 hour	1,439	4,375	5,814	23,000	25.3%
CO	8 hour	144	1,822	1,966	10,000	19.7%

The present proposal to add separate mass-based emission limits for steam turbine cold startups would not change the conclusions of the previous air quality analyses for MLPP. Daily and annual emissions would be unchanged because Duke proposes to limit the number of hours that could be spent annually in the steam turbine cold startup or combustor tuning modes. In the Final Staff Assessment, staff analyzed and demonstrated that emissions during startup (i.e., worst case for short-term impacts) and normal operation would comply with applicable laws, ordinances, regulations, and standards and that the emissions would not cause significant air quality impacts (CEC 2000a, pp. 46 and 58). Because startup emissions were characterized on an hourly basis and the proposed tuning emissions would be identical; the analysis for startups adequately characterizes the air quality impacts that would occur during steam turbine cold startup and combustor turning within the proposed emission limits. No additional mitigation is necessary.

The proposed changes affect conditions that currently reference or constrain startup emissions or need to include combustor tuning (**AQ-12, 14-17, 19 28, 30 and 31**). Conditions AQ-48 and 49 are added limit the number of combustion turbines that can operate in support of a steam turbine cold startup and to limit the number of hours per year (30 or less) that any one combustion turbine can cold start or combustor tune. No changes are proposed for the limits on exhaust concentrations

that apply to normal operation of the CTGs (**AQ-16**), and no changes are proposed for the daily limits on combined emissions from the CTGs (**AQ-14**), which presently account for startup and shutdown conditions. General conditions that presently limit quarterly and annual emissions from MLPP (**AQ-28**) would also remain unchanged.

Note that staff is proposing to revise AQ-40 to conform to the current ammonia testing requirement specified in the Permit to Operate (PTO). The revision reflects a District agreement and the current PTO (District 2003a).

MITIGATION

Duke proposes to amend conditions to accommodate the proposed frequency, duration and emission limits for steam turbine cold startup and combustor tuning. No other operational or mitigation changes would be necessary.

CONCLUSIONS AND RECOMMENDATIONS

Duke Energy Moss Landing LLC, the owner of the Moss Landing Power Plant, proposes to modify air quality conditions by adding separate mass-based emission limits for steam turbine cold startup and combustor tuning conditions. The worst case startup and combustor tuning conditions were evaluated, and proposed changes will not alter the conclusions presented in the Final Staff Assessment (CEC 2000a). The proposed changes do not alter the presently allowed daily, quarterly, or annual emissions. Note that staff is proposing to revise AQ-40 to conform to the current ammonia testing requirement specified in the Permit to Operate. Proposed revised Conditions of Certification are shown below with the deleted text in strikethrough and new text underlined.

CONDITIONS OF CERTIFICATION

AQ-6 Duke Energy Moss Landing LLC shall surrender the offsets identified in this evaluation prior to combusting fuel in the Gas Turbines.

Verification: The project owner shall provide copies of the Emission Reduction Credits (ERCs) to the District and the CEC CPM prior to combustion of fuel in the gas turbines.

AQ-12 At the end of the commissioning period, Duke Energy Moss Landing LLC shall conduct a District and CEC approved source test to determine compliance with ~~Condition 15 (for shutdown limits) and Condition 17 (for start-up limits)~~. The written test results of the performance tests shall be provided to the District and the CEC CPM following the testing. The source test shall determine NO_x, CO, and VOC emissions during start-up and shutdown of the Gas Turbines. The source test for each Gas Turbine shall include a minimum of three start-up and three shutdown periods. A complete test protocol shall be submitted to the District no later than thirty (30) days prior to testing, and notification to the District at least ten (10) days prior to the actual date of testing shall be provided so that a District observer may be present. Changes to the test date made subsequent to the initial ten day

notification may be communicated by telephone or other acceptable means no less than forty-eight (48) hours prior to the new test date.

Verification: A complete test protocol shall be submitted for approval to the District and the CEC CPM no later than thirty (30) days prior to testing, and notification to the District and the CEC CPM at least ten (10) days prior to the actual date of testing shall be provided so that District or Energy Commission observers may be present. Changes to the test date made subsequent to the initial ten day notification may be communicated by telephone or other acceptable means no less than forty-eight (48) hours prior to the new test date.

AQ-14 The maximum daily combined emissions from the Gas Turbines, including start-ups and shutdowns and combustor tuning periods, shall not exceed the following limits:

<u>Pollutant</u>	<u>Lbs/Day</u>
Oxides of Nitrogen (NOx)	2,589.4
Carbon Monoxide (CO)	17,301.8
Particulate Matter <10 microns (PM10)	864.0
Volatile Organic Compounds (VOC)	620.0
Ammonia (NH3)	1,224.0
Sulfur Dioxide (SO2)	124.0

Verification: See **AQ-38** and **39**.

AQ-15 The pollutant mass emission rates in the exhaust discharged to the atmosphere from each gas turbine shall not exceed the following limits:

<u>Pollutant</u>	<u>Lbs/Hour</u>	<u>Lbs/Day</u>
Oxides of Nitrogen (NOx)	17.23	413.52
Carbon Monoxide (CO)	37.76	906.24
Particulate Matter <10 microns (PM10)	9.00	216.00
Volatile Organic Compounds (VOC)	4.79	115.04.96
Ammonia (NH3)	12.75	306.0
Sulfur Dioxide (SO2)	1.30	31.2

Protocol: These limits shall not apply during start-up, which is not to exceed four (4) hours, or during shutdown, which is not to exceed two (2) hours, or during steam turbine cold startup or combustor tuning, which are not to exceed six (6) hours. SCR catalytic controls and good engineering practices shall be used to the fullest extent practical during start-up, and shutdown and combustor tuning to minimize pollutant emissions.

Steam turbine cold start-up periods are start-up periods that follow a shutdown of the steam turbine for at least 72 hours. Combustor tuning activities include all testing, adjustment, tuning and calibration activities recommended by the gas turbine manufacturer to insure safe and reliable steady state operation of the gas turbines following replacement of the

combustor. This includes, but is not limited to, adjusting the amount of fuel distributed between the combustion turbine's staged fuel systems to simultaneously minimize NOx, CO, and VOC production while ensuring combustor stability.

Verification: See AQ-38 and 39.

AQ-16 The pollutant concentrations discharged to the atmosphere from each Gas Turbine shall not exceed the following limits, calculated at 15 percent O2 on a one-hour rolling average unless otherwise noted:

Pollutant	Concentration (ppm)
Oxides of Nitrogen (as NO2)	2.5
Carbon Monoxide (CO)	9.0 (rolling three-hour average)
Ammonia (NH3)	5.0 (3-60 minute averages.)

These limits shall not apply during start-up, which is not to exceed four (4) hours, ~~or during~~ shutdown, which is not to exceed two (2) hours, or during steam turbine cold startup or combustor tuning, which are not to exceed six (6) hours. SCR catalytic controls and good engineering practices shall be used to the fullest extent practical during start-up, shutdown and combustor tuning to minimize pollutant emissions.

Verification: See AQ-38 and 39.

AQ-17 The pollutant emission rates discharged to atmosphere from each gas turbine during a start-up, ~~or shutdown,~~ or combustor tuning activities shall not exceed the following limits. These limits apply to any start-up period, which shall not exceed four (4) hours, and to any shutdown, which shall not exceed two (2) hours, and to any steam turbine cold startup or combustor tuning, which are not to exceed six (6) hours.

Pollutant	<u>Lbs/Start-Up</u>	<u>Lbs/Cold Startup or Combustor Tuning</u>	<u>Lbs/Shutdown</u>
Oxides of Nitrogen (as NO2)	320.0	<u>480.0</u>	160.0
Carbon Monoxide (CO)	3,608.0	<u>5,412.0</u>	1,804.0
Volatile Organic Compounds (as CH4)	64.0	<u>214.0</u>	32.0

Verification: See AQ-38 and 39.

AQ-19 CEM Systems shall be installed and operated on each of the Gas Turbines. These systems shall be designed to continuously record the measured gaseous concentrations, and calculate and continuously monitor and record the CO, CO2 or O2, and NOx concentrations corrected to fifteen (15) percent oxygen (O2) on a dry basis.

The equipment installed for the continuous monitoring of CO shall be maintained and operated in accordance with 40 CFR Part 60 Appendix F, and the equipment installed for the continuous monitoring of CO₂ or O₂ and NO_x shall be maintained and operated in accordance with 40 CFR Parts 72 and 75.

For periods of missing CO data, CO hourly values shall be substituted from valid hourly average data from the previous thirty (30) unit operating days, excluding periods of startup, ~~and shutdown~~, and combustor tuning. The CO data shall be substituted based on equivalent incremental load ranges.

Verification: See AQ-38 and 39.

AQ-28 Cumulative emissions, including emissions generated during Start-ups, ~~and~~ Shutdowns and Combustor Tuning Activities, from all power generation equipment at the Moss Landing Power Plant shall not exceed the following quarterly limits:

Pollutant	Pounds Of Emissions Per Calendar Quarter			
	First	Second	Third	Fourth
NO _x (as NO ₂)	286,778	285,301	409,492	336,584
Sox	23,823	24,567	32,613	29,468
VOC	144,537	150,294	212,540	188,206
PM ₁₀	213,533	221,488	307,505	273,879
CO	2,929,068	3,059,753	4,472,774	3,920,385

Verification: See AQ-38 and 39.

AQ-30 Duke Energy Moss Landing LLC shall demonstrate compliance by using properly operated and maintained continuous emission monitors (during all hours of operation including equipment Start-up and Shutdown periods and Combustor Tuning Activities, except for periods of CEM maintenance performed in accordance with District requirements) for all of the following parameters:

- Firing hours and Fuel Flow Rates.
- Oxygen (O₂) Concentrations, Nitrogen Oxide (NO_x) Concentrations, and - Carbon Monoxide (CO) Concentrations.
- Ammonia Injection Rates.

Duke Energy Moss Landing LLC shall record all of the above parameters every 15 minutes (excluding normal calibration periods) and shall summarize all of the above parameters for each clock hour. For each calendar day, Duke Energy Moss Landing LLC shall calculate and record the total Firing Hours, the average hourly Fuel Flow Rates, and pollutant emission concentrations.

Duke Energy Moss Landing LLC shall use the parameters measured above and District-approved calculation methods to calculate the following parameters:

- d. Heat Input Rate.
- e. Corrected NO_x concentrations, NO_x mass emissions (as NO₂), corrected CO concentrations, and CO mass emissions.

For each source, Duke Energy Moss Landing LLC shall record the parameters specified in d. and e. of this Condition every 15 minutes (excluding normal calibration periods). As specified below, Duke Energy Moss Landing LLC shall calculate and record the following data:

- f. Total Heat Input Rate for every clock hour.
- g. The NO_x mass emissions (as NO₂), and corrected NO_x emission concentrations for every clock hour.
- h. The CO mass emissions, and corrected CO emission concentrations for every rolling three-hour period.
- i. On an hourly basis, the cumulative total NO_x mass emission (as NO₂) and the cumulative total CO mass emissions.
- j. For each calendar day, the cumulative total NO_x mass emission (as NO₂) and the cumulative total CO mass emissions.
- k. For each calendar quarter, the cumulative total NO_x mass emission (as NO₂) and the cumulative total CO mass emissions.
- l. For each calendar year, the cumulative total NO_x mass emission (as NO₂) and the cumulative total CO mass emissions.

Verification: See AQ-38 and 39.

AQ-31 Duke Energy Moss Landing LLC shall calculate and record on a daily basis, the Volatile Organic Compound (VOC) mass emissions, Fine Particulate Matter (PM₁₀) mass emissions, Sulfur Dioxide (SO₂) mass emissions, and Ammonia (NH₃) mass emissions from each source. Duke Energy Moss Landing LLC shall use the actual heat input rates, actual Start-up times, actual Shutdown times, actual Combustor Tuning times and District-approved emission factors to calculate these emissions. The calculated emissions shall be presented as follows:

- a. For each calendar day, VOC, PM₁₀, SO₂, and NH₃ mass emissions shall be summarized for each source.
- b. On a daily basis, the cumulative total VOC, PM₁₀, SO₂ and NH₃ mass emissions shall be summarized for each calendar quarter and for the calendar year.

Verification: See AQ-38 and 39.

AQ-40 The owner/operator shall cause ~~quarterly monthly (or less frequently if deemed by the Air Pollution Control Officer)~~ testing to be performed to verify compliance with the Ammonia (NH₃) slip limit. Duke Energy Moss Landing LLC shall conduct this testing in accordance with the collection method specified in BAAQMD Source Test Procedure ST-1B and the analysis specified in EPA method 350.3.

Verification: See AQ-38 and 39.

AQ-48 Not more than one of the Gas Turbines shall be operated in support of a steam turbine cold startup or undergo combustor tuning at any one time.

Verification: See Condition AQ-49.

AQ-49 The total number of hours during which each Gas Turbine may be operated to support a steam turbine cold startup or may undergo combustor tuning shall not exceed 30 hour per year (each Gas Turbine).

Verification: The owner/operator shall record the start time, end time and duration of each steam turbine cold startup and each combustor tuning period. On an annual basis, the owner/operator shall report the total number of hours during which each gas Turbine operated to a support a steam turbine cold startup or in combustor tuning mode during the year.

REFERENCES

California Energy Commission (CEC) 2000a. Final Staff Assessment - Part II, Moss Landing Power Plant Project (Docket No. 99-AFC-4), June 1, 2000.

California Energy Commission (CEC) 2000b. Commission Decision, Moss Landing Power Plant Project (Docket No. 99-AFC-4), October 25, 2000.

Duke Energy Moss Landing LLC (Duke) 2003a. Request for Amendment Moss Landing Power Project. 99-AFC-4C. May 27, 2003

Duke Energy Moss Landing LLC (Duke) 2003b. Request for Amendment Moss Landing Power Project AQ-6, 12, 14-17, 19, 28, 30, 31, 48 and 19. 99-AFC-4C. September 2, 2003.

Duke Energy Moss Landing LLC (Duke) 2003c. Moss Landing Power Project Minor Amendments to Title V Permit No. TV28-01. September 22, 2003.

Duke Energy Moss Landing LLC (Duke) 2002. Petition to Amend Various Air Quality Conditions. Docket No. 99-AFC-4C. Received in Dockets November 12, 2002.

Monterey Bay Unified Air Pollution Control District (District) 2003a. Mr. Mike Sewell to Mr. Steve Abbott, AMMONIA SLIP TESTING REQUIREMENT. July 10, 2003.

Monterey Bay Unified Air Pollution Control District (District) 2003b. Transmittal of Public Noticed Permits - Duke Energy Mods. October 2, 2003.

Monterey Bay Unified Air Pollution Control District (District) 2003c. Permit to Operate - Duke Energy. December 4, 2003.